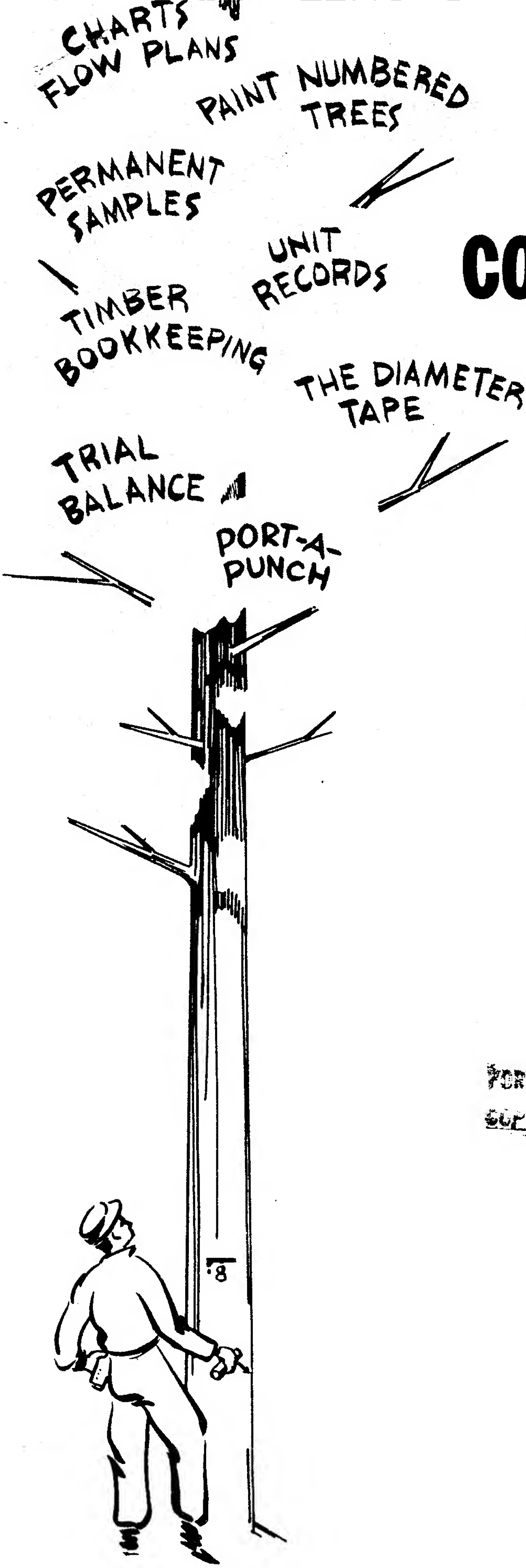
FOREST CONTROL *by* CONTINUOUS INVENTORY

"Today I have grown taller from walking with the trees."
...Karle Wilson

Milwaukee, Wis. July, 1965 No. 136



IT MIGHT HAVE BEEN SAID OF PROGRAMMING

A little learning is a dangerous thing;
Drink deep, or taste not the Pierian spring;
Their shallow draughts intoxicate the brain,
And drinking largely sobers us again.

POPE

Essay on Criticism

The Forester

THE TREE DETAIL ERROR

The tree detail error check is a necessary part of processing C.F.I. data. It helps insure that data gathered in the field are free of detectable errors. It helps to insure that these data will be properly prepared for further processing and that costly machine delays and re-runs will not be necessary. It also helps in the development of clear and complete field instructions. Ideally, it is completed before field work begins. It may then be used as a training aid in explaining field instructions. It helps the trainer stress the need for careful measurement, estimation, and recording -- that is, the need for precision in the field.

For computer application the error check must be programmed. A prerequisite to the computer program is the block diagram, or program flow chart. It is an outline which shows the steps that must be taken by the program to detect errors in the data and indicate to the forester the nature of the errors. It helps translate the forester's terminology into the programmer's language. In fact, it serves as a bridge between the two, for both forester and programmer help build it and each uses it for communication with the other.

In this newsletter a simple tree detail error check is illustrated. Our purpose is not to argue for or against particular classifications of data. Rather, it is to demonstrate how, through an error check program, data may be compared to established standards, and to show the logical steps which such a test follows in detecting deviations from these standards. We have not included a written program based on the illustrations. It is not necessary for an understanding of the subject and it would require an involved explanation which is beyond the scope of this paper.

The material which follows should be readily understood after a careful reading or two. In addition to the remainder of the text there are: a set of simple standards and codes; a general block diagram which indicates broadly what errors were tested for; a detailed block diagram; an explanation of symbols used; a sheet of sample data such as might be used for testing the error check program; and a portion of a listing of erroneous data from an actual C.F.I. case.

It should be understood that several assumptions were made in preparing this material. The Simple Sample Forest is, of course, imaginary, as are the sample data. Standards and codes have been kept simple for reasons of brevity and clarity. The forest has no sawtimber. Trees are either pulpwood or culls. To have included other tree status classes of live trees would have unduly lengthened and complicated the diagrams and explanation. Species are similarly limited. The 40-inch diameter limit shown is an estimated maximum. It was set as a top limit in order that the program could detect the occasional gross diameter error that might otherwise escape notice. Dimensional changes on ingrowth and repeater trees are also estimated maximums.

The term "Repeater Tree" as used here means a tree alive at both measurements but not necessarily of the same tree status both times. Also, we have used a "safety valve" which we call the "Change" field. It allows the estimator, when he detects an exception to the rules, to indicate this in the field card. Later, when the error check program detects the exceptional situation, it will test for the proper "Change" code and not indicate an error.

Having decided what data to gather and what standards and codes to use, we next had to decide what errors we want to find. We want the check to be thorough but not unnecessarily refined. Mainly we want to be sure that (1) there are no double-punches or blank columns in any fields; (2) the codes used are those allowed and established by our standards; (3) the relationships between items of data at each measurement are as defined; (4) exceptions to the rules are detected. The general system diagram (Figure 2) shows what errors we will test for and at what stages in the flow of data through the error test. The dashed symbols near the bottom of the diagram (and of Step 77, Figure 4) indicate two of several optional forms of error reports we might have selected.

In our example we have assumed that our records-control procedures and subsequent report generation are such that we need only check for plot and tree number range. Duplicate and missing plot and tree numbers might have been tested for but in this example were not.

In order to be of use to all concerned, the error check system diagram must be expanded to indicate in detail what tests are to be made, what the data limits are and what is to be done in each situation which develops as a result of the tests. Figure 4 shows this detail. The symbols used are explained in Figure 3 and on P1 of Figure 4.

It should be understood that although the data cards pass through the card reader at the rate of several hundred per minute, each card is tested individually before the next card is read. All questions, decisions and actions, from "Read" at Step 2 to "Is this the last card?" at Step 79, are completed before the computer "asks" for another card to be read, or in the case of the last card, prints the card-count and halts.

Most cards, whether error free or not, will pass through most of the steps indicated on P1, 2, 3, 5 and 6 of Figure 4. Culls will bypass, or branch around, steps 38-45 because they must have soundness 9 and vigor 4. These are tested at Steps 34 and 36 after which culls are carried to letter (C) for comparisons of old and new data.

Dead trees (TS 5) and cut-and-used trees (TS 6) branch away from the main path at Steps 20 and 23 to letter (B) which is shown on P4. Here old data are tested which affect volume of the tree. Vigor has no place in the volume calculation so it is not tested, though it may be if it is desired.

Figure 5 is an example of test data which may be used in testing the program. Each line represents one data card, or one tree. Hopefully, each contains one error. In actual testing a more complete deck of test cards is key-punched from a similar list and passed through the programmed computer. Each of the errors should be detected and indicated on the print-out. No errors should be indicated which do not exist. It is not necessary to make test data for every error which could occur, but each class of error should be included in the test deck.

Using these examples, mentally pass some of the cards through the block diagram and see where errors are indicated. Make up data of your own to test the diagram. Occasionally one type of error will be indicated when actually another exists. For example, a tree which is dead and thus has no new data may have been miscoded as Tree Status 2-2 instead of 2-5. Since 2-2 is an allowable combination under the standards in Figure 3, the errors indicated will be in DBH, UL, soundness, Vigor, etc. This is not a serious problem. Each erroneous card must be examined by the forester and he will soon see where the trouble lies and easily correct it.

Figure 6 is an example of an error listing (Figure 4, Step 76) in which all the data in each error card are printed. Asterisks over particular items of data indicate errors. In cases of blanks, the asterisks appear over blank spaces where the data should be. Such a list is most useful to the forester who may study it, make red pencil corrections, and send it to the key puncher. The key punched cards are error checked, and when finally correct, are substituted for the original erroneous cards, which were selected in the Collator with the aid of the error finder cards.

As previously mentioned, the creation of an error finder card (Figure 4, Step 77) is optional. It is punched by the computer when an erroneous card has been tested. After an error check run it may be used in the collator to select error cards from the deck of data cards. It is a standard, plain, 80-column card. Plot number and tree number of the erroneous card are punched into the finder card by the computer. An 11-zone punch, or X-punch, is also punched in any one of the remaining columns. The column X-punched indicates the kind of error which exists in the data card. An X-punch in column 10, for example, might indicate an error in the plot number field. An X-punch in column 11 might indicate an error in tree number. An X-12 might show a species error; X-13 another type of error, and so on.

There are numerous variations of this general procedure. Each case differs from the others and no detailed plan may be drawn which applies to all. But in general, if the steps outlined here are followed, an error check program may be written which will detect all important errors, and will save time and increase accuracy in error correction over hand and sorter methods. It will be a good check on the thoroughness of field instructions and it may be used by trainers in explaining field instructions and in developing an understanding of the need for accurate work in the field. And it will, of course, help to insure that correct data are being used in subsequent data processing and report generation.

Figure 1. Standards and Codes for The Simple Sample Forest

Plot Number	From 001 to 140. Plot number is the code.	
Tree Number	From 001 to 111. Tree number is the code.	
Species	Code 01 = Sugar Maple 02 = Red Maple 03 = Yellow Birch 04 = Basswood 05 = Elm 10 = Hemlock	Code 20 = Aspen 21 = Paper Birch 30 = White Pine 31 = Red Pine 40 = Miscellaneous
DBH	Minimum: 05.0" Maximum: 40.0"	DBH number is the code.
Usable **Length**	To nearest full 2 feet. Minimum: 04' Maximum: 98'	To 4.5" top dob. UL number is the code.
DBH-UL Comparison **(6 Multiplier)**	5" - 30' 6" - 36' 7" - 42' 8" - 48' 9" - 54' 10" - 60'	11" - 66' 12" - 72' 13" - 78' 14" - 88' 15"+- 98'
Soundness	Code 7 = 97% 3 = 93% 6 = 86%	Code 8 = 78% Never Vigor 1 5 = 65% Always Vigor 3 9 = 99% Cull
Vigor	Code 1 = Good 2 = Fair	Code 3 = Poor 4 = Cull
Tree Status	Old: Code 0 = Ingrowth 2 = Pulpwood 4 = Cull	New: Code 2 = Pulpwood 4 = Cull 5 = Dead 6 = Cut-&-Used

Comparisons between old **and new data**

DBH Change Maximum growth expected = 1.5" in 5 years
Ingrowth Tree: Maximum DBH = 06.4"
Repeater Tree: New DBH $\leq$ Old DBH + 1.5"

U L Change Maximum growth expected = 16' in 5 years
Ingrowth Tree: See DBH-UL comparison above
Repeater Tree: New UL $\leq$ Old UL + 16'

Soundness & Vigor Any change acceptable except from cull to commercial.

Tree Status Allowable Code Combinations: 0-2, 0-4, 2-2, 2-4, 2-5, 2-6, 4-4, 4-5

Change Code 0 = Dead tree or tree cut and used.
1 = Normal change: DBH & UL changes don't exceed limits shown.
3 = Abnormal change: DBH &/or UL changes exceed limit shown.

Figure 2. Tree Detail Error Check System Diagram (General)

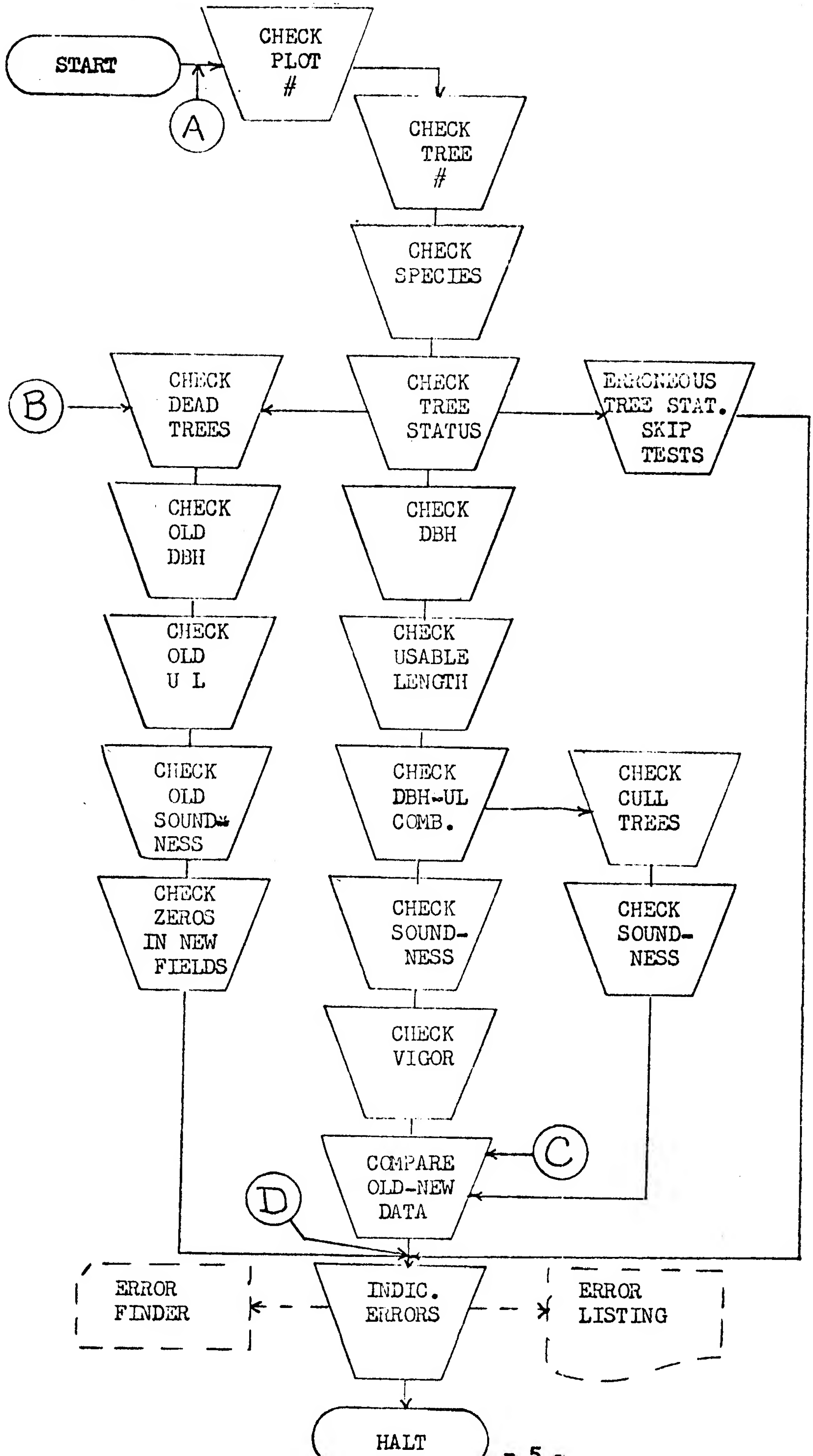
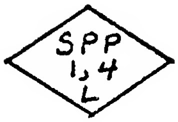


Figure 3. Symbols Used in the Simple Sample Forest Tree Detail Error Check System Diagram (Detailed).

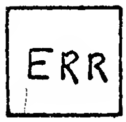


-- Question. In this case the question is: "Is the left-hand digit of the species code a 1 or a 4?"

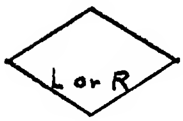
⟶ -- Direction in which action flows.

Y -- "Yes" answer to a question asked in a diamond.

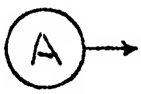
N -- "No" answer to a question asked in a diamond.



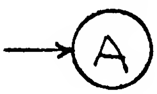
-- At these points computer internally chalks up an indication that an error has been found. Near the end of the diagram you will see the question, "Any Errors?", that is, were any errors chalked up? If so, they will be indicated in the error report.



-- "L" indicates "Left" or high-order position of a two-column field; "R" indicates "Right." In an actual case the particular card column numbers would be shown.



-- Position indicator.



-- This instruction means "Branch to A," i.e., go to the position indicated by encircled letter.

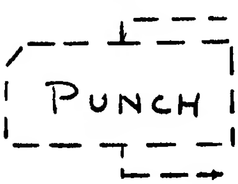
$\leqq$ -- Equal to or less than.

$\geqq$ -- Equal to or greater than.

Ø -- Old data, i.e., data from the previous measurement.

-- Compare old data fields to new data fields.

-- Is the card being tested the last data card?



-- Optional course of action. In this case the options are to punch or not to punch a card.

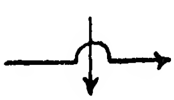
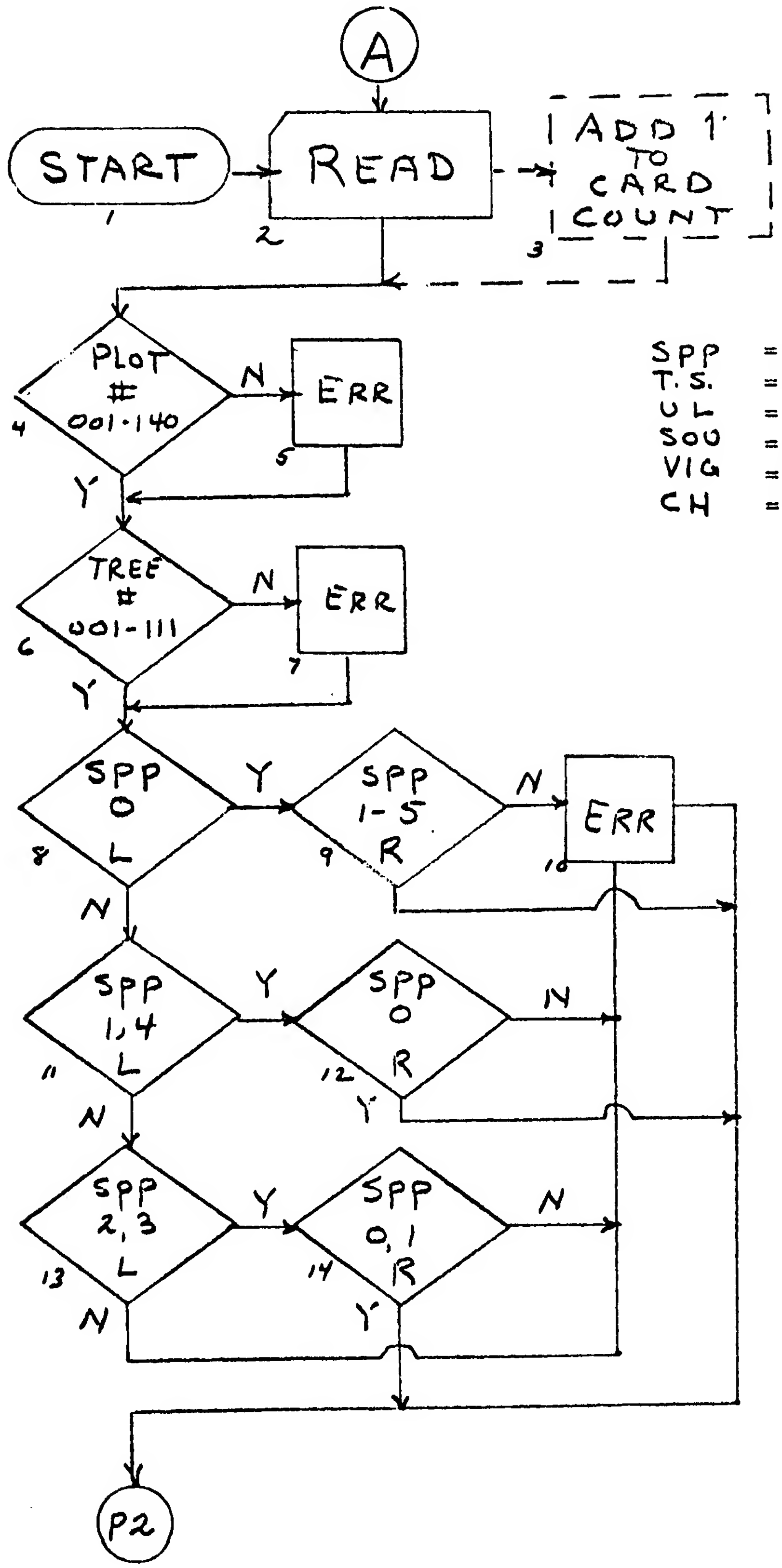

-- Two courses of data flow which do not intersect. (Such line-crossing is frowned on in the better block-diagramming and flow-charting circles).

Figure 4. Tree Detail Error Check System Diagram (Detailed)



SPP = Species
T. S. = Tree Status
U L = Usable Length
SOU = Soundness
VIG = Vigor
CH = Change

P2

Figure 4. (Continued)

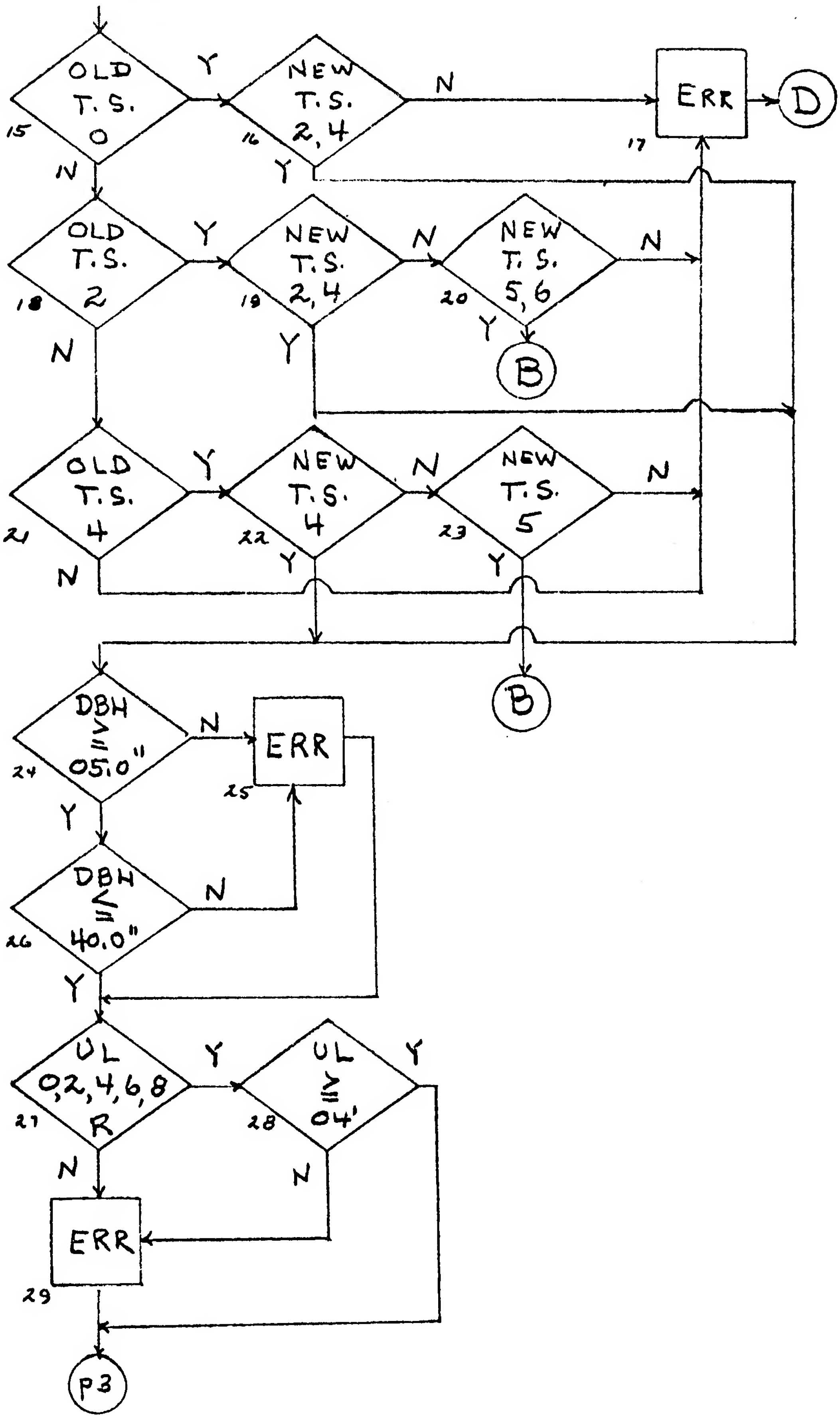


Figure 4. (Continued)

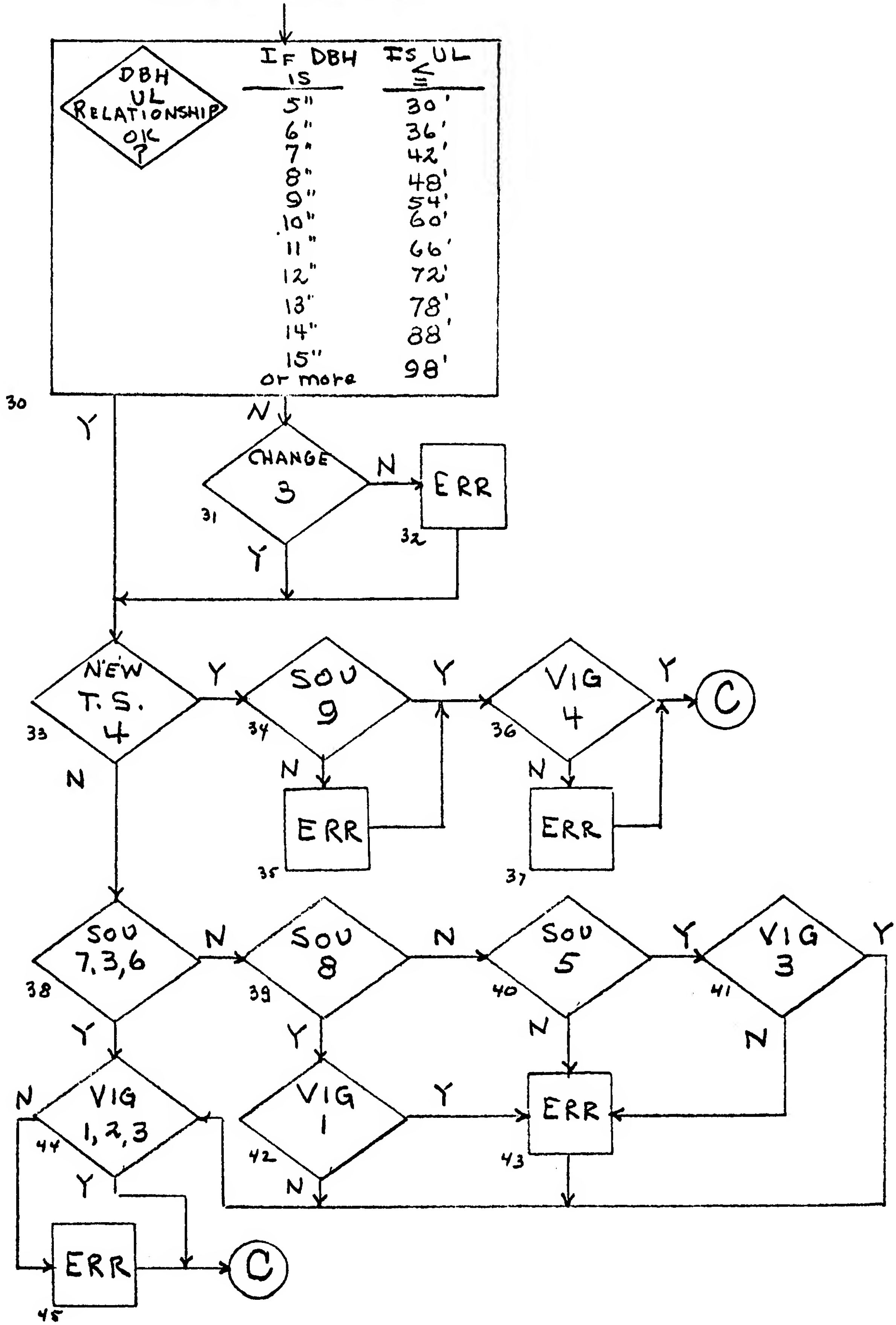


Figure 4. (Continued)

Tree Status 5 (Dead) and 6 (Cut-and-Used)

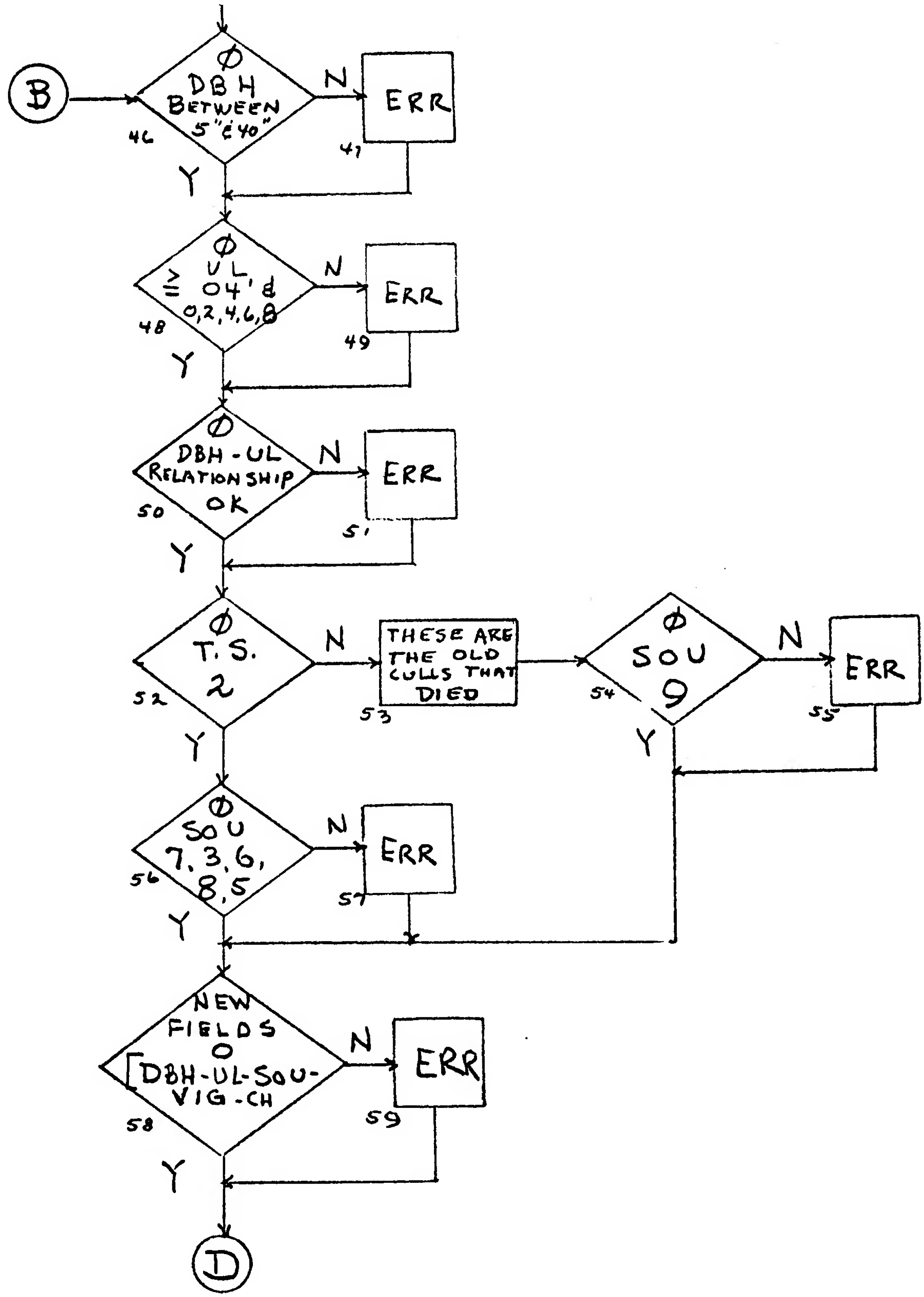


Figure 4. (Continued)

Comparisons Between Old and New Data

P5

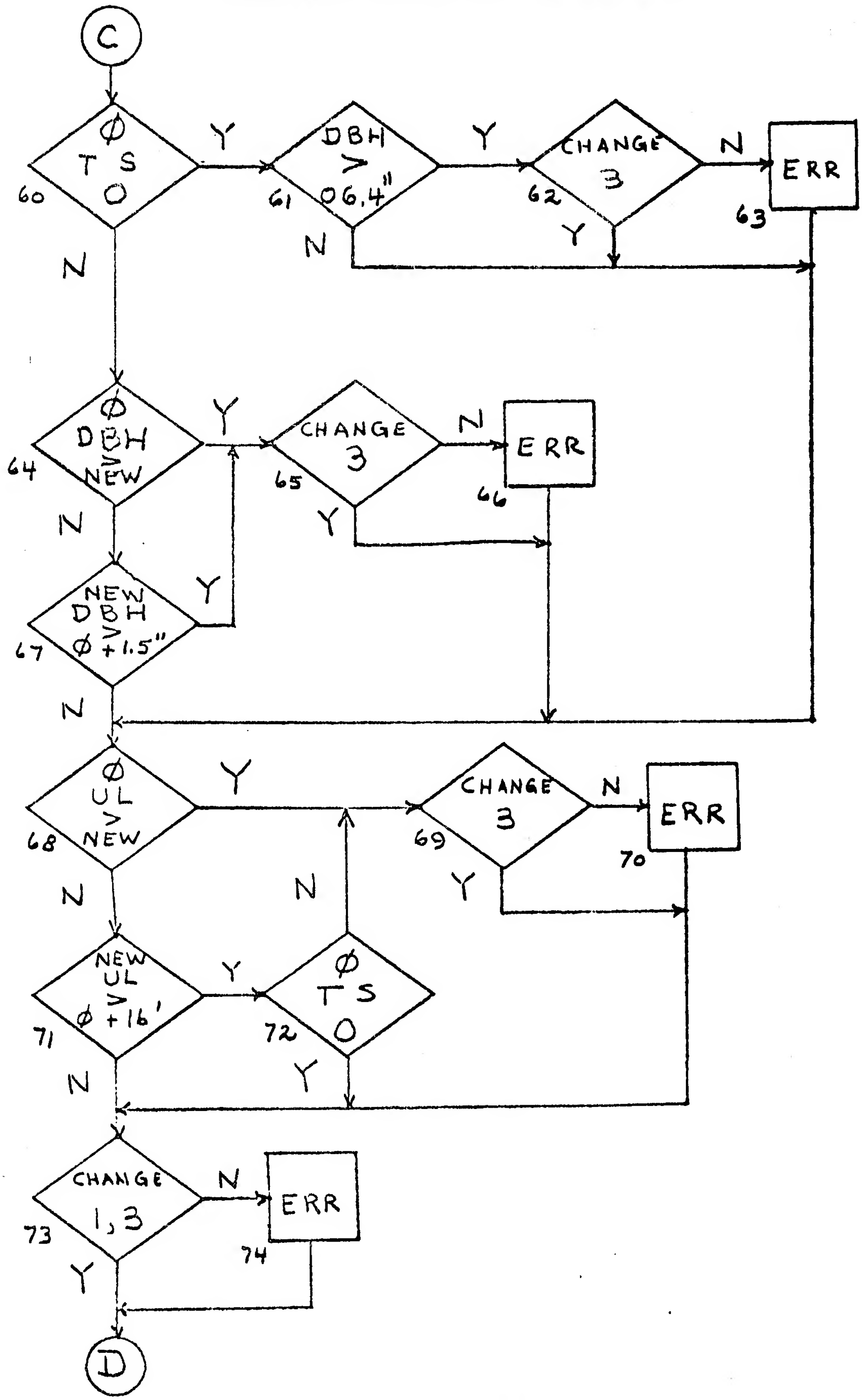


Figure 4. (Continued)

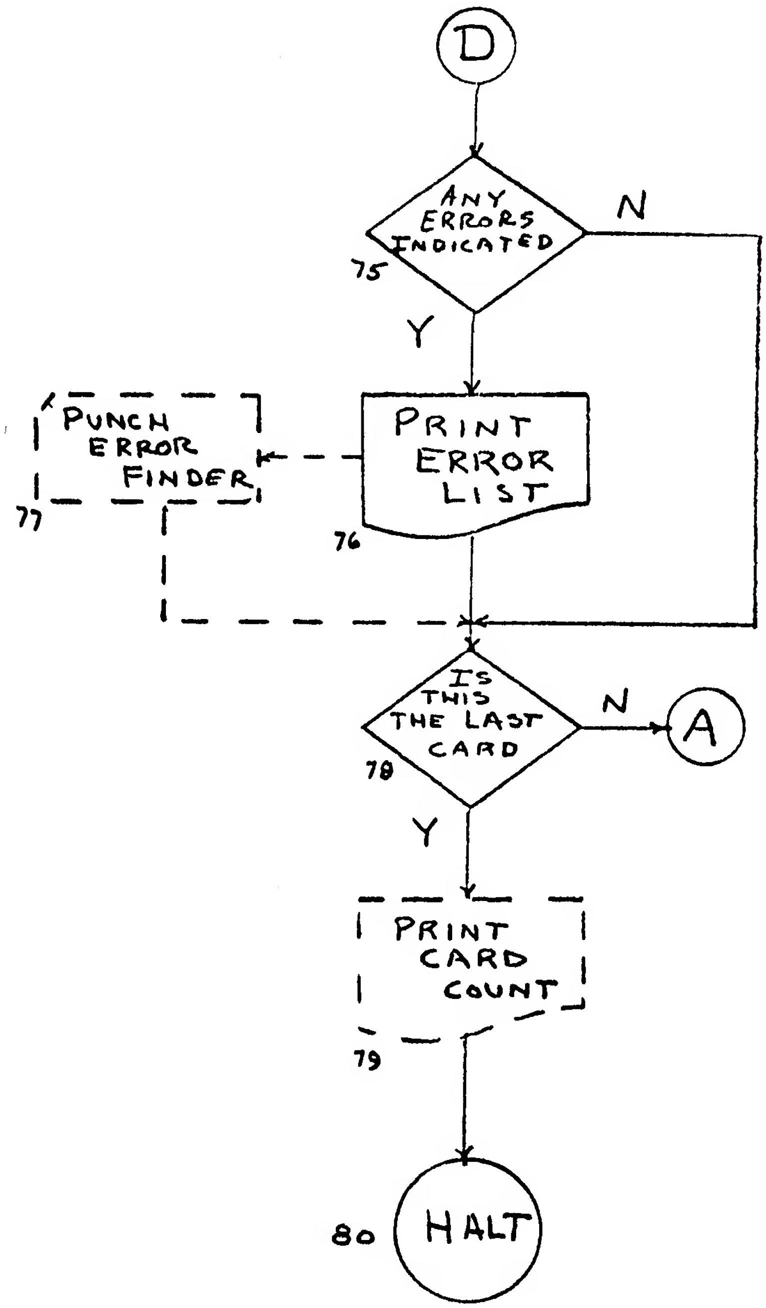


Figure 5. Sample Tree-Detail Data for Use in Testing the Error Check Program.

PLOT No.	TREE No.	SPP.	DBH		UL		SOU		VIGOR		TREE STATUS		CHANGE	COMMENTS
			OLD	NEW	OLD	NEW	OLD	NEW	OLD	New	OLD	NEW		
101	001	06	063	068	30	34	7	7	2	2	2	2	1	Incorrect Species
101	002	05	000	049	00	20	7	7	1	1	2	2	1	DBH too Small
101	003	01	063	068	30	34	7	8	1	1	2	2	1	Never Vigor 1 with Sou 8
101	004	01	063	068	30	34	7	7	4	4	2	2	1	Vigor 4 only for cull trees
101	005	01	063	080	30	36	7	7	1	1	2	2	1	DBH growth > 1.5" with change 1
101	006	01	063	070	30	34	7	0	1	0	2	6	0	Tree Status 6 with New DBH & UL
101	00A	01	063	068	30	34	7	7	1	1	2	2	1	Double-punch in Tree No.
1 1	008	01	063	068	30	34	7	7	1	1	2	2	1	Blank column in Plot No.

Figure 6. Example of Error Listing. All Data in each Card Printed. Asterisks Indicate Errors.

M-NO	FOREST	PLOT	TREE	SPEC	DBH	SAWLOG LEN	SAWLOG SOU	PULPWOOD LEN	PULPWOOD SOU	W.T. VIGOR	QUAL	LEN	T.S. OLD	T.S. NEW	M.G. POT	MORT KIND
19	3	019	21	11	0919	00	0	34	3	5	0	** 4/	* 5/	2	1	0
19	3	019	22	11	0927	00	0	34	3	3	0	** 4/	* 5/	2	1	0
19	3	020	05	69	1229	18	7	* 1/ 5K	7	6	3	10	* 6/	3	* 7/	0
19	3	C20	06	69	1281	18	3	38	3	6	3	08	* 6/	3	3	0
19	3	C20	07	11	2108	24	5	* 2/ 5-	5	6	3	16	* 6/	3	4	C
19	3	C20	11	69	1078	00	0	44	7	5	0	** 4/	* 5/	2	3	0
19	3	C20	13	20	0924	00	0	* 3/ 2K	6	6	0	** 4/	* 5/	2	4	0
19	3	020	16	C1	0958	00	0	24	7	2	0	** 4/	* 5/	2	1	0

1/ Should be 52
2/ Should be 50
3/ Should be 22
4/ Should be 00
5/ Should be 2
6/ Should be 3
7/ Should be an allowable Mgt. Potential Code; in this case 1.

FIELD SCHEDULE FOR THE COOPERATIVE FOREST INVENTORY BRANCH IN 1965

July 12 - 16	CFI remeasurement, Northwest Paper Company, Cloquet, Minnesota. Stott and Branam
July 19 - 23	CFI remeasurement, Gogebic County, Bessemer, Michigan. Stott and Branam
July 26 - 29	CFI remeasurement, Cleveland-Cliffs Iron Company, Munising, Michigan. Smith
August 16 - 20	CFI establishment, Indiana State Forest Service, Indianapolis, Indiana. Stott and Branam
August 23 - 27	CFI remeasurement, Muskingum Conservancy District, New Philadelphia, Ohio. Stott and Branam Follow-up check by Smith in Gogebic County if needed. ADP standardization plans. Stott.
September 13 - 24	CFI quality grading and economic study on 27-year-old samples. ADP standardization plans, L'Anse, Michigan. Stott and Branam Follow-up check by Smith or Stott on C.C.I. case if needed.
October 11 - 15	CFI Purdue project in local woods. Stott and Branam
October 18 - 22	CFI - ADP standardization plans at L'Anse, Michigan. Stott and Branam
October 23 - 27	SAF meeting in Detroit, Michigan. Stott, Smith Follow-up check by Smith or Stott on Indiana State CFI if needed.
November 1 - 12	CFI remeasurement assistance wherever most needed. Smith or Stott
GENERAL COMMENT	Office work for the season will include the completion of Pioneer Forest and U.S.B.I.A. data processing projects for CFI cases, by Smith; the preparation of papers and articles on CFI by Stott, and the development of a winter season ADP school plan for Smith.